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SCN 175T.02: Integrated Science

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**INTEGRATED SCIENCE
SCN175T
COURSE SYLLABUS**

Course Title: SCN 175T Integrated Science
Semester Credits: 3
Professor: Ashley Preston
Office: HB Building, East Campus, College of Technology
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Email: ashley.preston@umontana.edu
Office Hours: MW 11:30-1:00 or by appointment
Prerequisites or Co-requisites: MAT 005 (Math 100 Suggested)

Course Description: The course offers an introduction to the scientific method as a tool for understanding natural phenomena. The course begins with an examination of the scientific method, introducing students to methods of observation, data collection, experimentation, validation, interpretation, and theory building. Science is presented as an ongoing process, one that aims to construct a seamless web of knowledge about the workings of the world around us and the universe as a whole. SCN175 takes an integrated approach to the presentation of basic concepts and principles in physics, chemistry, and biology. Topics emphasized include: mechanics, energy and thermodynamics, electricity and magnetism, waves and electromagnetic radiation, the atom, quantum mechanics, basic chemistry, the nucleus, and basic biology. In each instance, connections between the branches of science are emphasized, focusing on real-world situations and applications, especially those in the medical and health sciences.

Required Text: Trefil and Hazen. 2004. *The Sciences: An Integrated Approach*, 4th edition. John Wiley and Sons, Inc. ISBN 0-471-21963-0

Student Learning Outcomes: Upon completion of this course, the student will be able to:

1. Understand and critically evaluate the merit of basic scientific claims and /or findings encountered in education, the workplace, the marketplace, or the media.
2. Identify and differentiate between observations, hypotheses, theories, and laws (e.g., to understand the scientific method and its relationship to creativity, logic, and intuition).
3. Gather information, interpret observations, and quantify data on natural phenomena.
4. Recognize patterns in natural processes and structures; formulate and test elementary predictions based on pattern recognition; draw conclusions and construct hypotheses and/or theories.
5. Understand the meaning and broader significance of the basic principles and concepts of the major scientific disciplines.
6. Make connections between the different sciences to construct an integrated web of knowledge about the natural world.
7. Apply scientific methods and principles to real-world situations; assess the social, economic, political, environmental, and ethical impacts of scientific findings or research agendas.

Students with Disabilities will receive appropriate accommodation. Please see me after class or in my office. Please bring a letter from your DSS Coordinator.

Attendance and Participation

Attendance is required. Students are expected to attend every class, to come on time, and to hand in all work assignments on time. If you cannot make a test, you must see me BEFORE the test date, and you will be expected to make up the test BEFORE the regularly scheduled test date. Class attendance and participation is expected and will impact grades. Make-up tests can be scheduled in the ASC center and require 48 hour advance notice.

Assessment Methods and Grading

1. Five **Unit Tests**
2. The **summaries** must demonstrate an increasing ability to read, interpret, and evaluate current scientific research and publications.
3. **Oral** summary presentations
4. A comprehensive **Final Exam**

Unit Tests (5 @10% each)	50%
Summaries (10)	15%
Oral presentation/attendance/participation	20%
Final Exam	<u>15%</u>
	100%

Grading Scale

A = 94 – 100	B = 83 – 86	A- = 90 - 93
B+ = 87 - 89	C = 73 - 76	B- = 80 - 82
C+ = 77 – 79	D = 63 – 66	C- = 70 - 72
D+ = 67 – 69		D- = 60 - 62
F = 59 and below		

Instructions for Summaries and Oral Presentations

There are four objectives for these summaries and presentations.

1. To give the student an opportunity to follow/develop a personal interest in science.
2. To familiarize the student with the language and methods of professional science through reading *peer reviewed* journals.
3. To develop the ability to summarize major scientific findings and communicate these insights to others.
4. Enable others to share and benefit from the work and interests of each individual class member.

Several publications in the COT/UM library may be used for these reviews. The minimum requirement is that the publication be peer reviewed. Examples of publications that may be used to complete this assignment include: *Science News*, *The Journal of the American Medical Association (JAMA)*, *Scientific American*, *Lancet*, PLoS (online, link can be found on Blackboard), *Nature*, etc.. (Note: *Science News* is also available online at www.sciencenews.org).

Students are expected to scan weekly a peer reviewed journal of interest to you. Read and take notes on at least one article. Write a brief, **typewritten, double-spaced summary** of the article and save it in a folder. Be sure to provide a **citation** for the article, as well as to attach a **copy of the source article** to the summary.

Several times during the semester students will verbally share the results of their research with the class as a whole, or in small groups as indicated by the instructor. Portfolios will be turned in at different times during the semester (as indicated on the course schedule).

Online Supplement

This course is accompanied by an online supplement. Study questions, chapter notes, web addresses for science journals, grades, and other course information will be available on Blackboard.

Detailed Course Outline and Learning Objectives

Unit I: Introduction, Chapters 1-3

Learning Objectives: Upon completion of this unit you will be able to:

- 1) Identify ways science and scientific findings impact daily life.
- 2) Describe how the social context and level of technology affect the progress of science.
- 3) Identify the components of the scientific method, explain the relationship between components.
- 4) Compare and contrast science and pseudoscience.
- 5) Understand the power and limits of the scientific method and the areas of inquiry to which it can be successfully applied.
- 6) Begin to place scientific discoveries in historical context.
- 7) Define and differentiate between speed, velocity, and acceleration.
- 8) Understand the basic principles of motion.
- 9) Describe, apply, and interpret the significance of Newton's Laws of Motion.
- 10) State and understand the meaning of the law of universal gravitation, and the force of gravity.
- 11) Define and give examples of inertia, momentum, and angular momentum.
- 12) Compare and contrast force, work, energy, and power.
- 13) State and understand the meaning of the first law of thermodynamics.
- 14) Understand energy and energy flows.

Unit II: Chapter 4-6

Learning Objectives: Upon completion of this unit you will be able to:

- 1) Distinguish between heat and temperature.
- 2) Demonstrate an understanding of specific heat capacity and its relationship to heat transfer and/or insulation.
- 3) Define and calculate efficiency in terms of energy transfers.
- 4) Define entropy.
- 5) State, and understand the significance of, the second law of thermodynamics; compare and contrast it with the first law.
- 6) Identify the connection between energy, heat, order, and the directionality of time.
- 7) Understand the relationship between evolution and the second law of thermodynamics and between universal heat death and the second law of TD.
- 8) Discuss the implications for human activities of the second law of thermodynamics.
- 9) Define and understand electricity.
- 10) Differentiate between static electricity and an electrical current.
- 11) Discuss electricity in terms of energy conversions, differentials, electrons, and electric fields.
- 12) Identify and explain the basic components and workings of an electric circuit in terms of power source, pathway, and load.

- 13) Understand the meaning of amps, volts, ohms, and watts.
- 14) Explain the basic construction and chemistry of a battery and how it creates and electrical current.
- 15) Define and understand magnetism.
- 16) Identify the properties of magnets and explain the basic principles of magnetic force.
- 17) Discuss the relationship between electricity and magnetism.
- 18) Identify Maxwell's four equations/formulations and explain their significance for our use and understanding of the electromagnetic force.
- 19) Identify the parts of a basic electromagnet, electric motor, and dynamo. Explain how each technology applies or takes advantage of the principles of electromagnetism.
- 20) Identify and explain waves in terms of length, frequency, amplitude, and velocity.
- 21) Define and differentiate between longitudinal and transverse waves, between constructive and destructive interference.
- 22) Explain and give examples of the Doppler effect (light and sound).
- 23) Describe electromagnetic radiation.
- 24) Quantify the speed of light.
- 25) Define and give examples of reflection, absorption, and scattering.
- 26) Describe the electromagnetic spectrum; identify and give examples of its components.
- 27) Identify and explain the biological effects of different wavelengths of electromagnetic radiation.
- 28) Identify and explain the basic principles applied in technologies such as MRIs, X-rays, sonar/radar, microwaves, and radios.

Unit III: Chapters 8-10

Learning Objectives: Upon completion of this unit you will be able to:

- 1) Define the atom, explain its structure and the relationship of its parts; discuss the merits of different models.
- 2) Discuss the development of atomic theory.
- 3) Explain the organizational rationale behind the periodic table of elements.
- 4) Differentiate between elements, atoms, molecules.
- 5) Explain how an element's chemical activities are related to its structure and properties.
- 6) Identify matter using a spectrometer and the basic principles of spectroscopy.
- 7) Describe the relationship between chemical composition and spectroscopy.
- 8) Explain the basic principles and meaning of quantum mechanics and quantum theory.
- 9) Define quanta.
- 10) State, discuss the evidence for and the implications of (for classical physics and human society) Heisenberg's Uncertainty Principle.
- 11) Identify the evidence for and then describe the wave-particle duality. (double-slit experiment)
- 12) Describe ionic, metallic, covalent bonds, and van der Waals forces.
- 13) Identify at least 4 states of matter; explain them in terms of chemical structure.
- 14) Discuss the relationship between chemical reactions and energy transfers.
- 15) Identify the different hydrocarbons in terms of their chemistry and energy signatures.

Unit IV: Chapters 12-13

Learning Objectives: Upon completion of this unit you will be able to:

- 1) Discuss the terms of Einstein's equation: $E=mc^2$
- 2) Discuss the organization of the atomic nucleus; differentiate between protons and neutrons.
- 3) Describe how the atomic number and atomic mass are related to the number of protons and neutrons.
- 4) Discuss and define isotopes and ions.
- 5) Name and discuss the properties of the force that holds the protons and neutrons together in the nucleus.
- 6) Define radioactive decay and indicate the difference between alpha, beta, and gamma decay.
- 7) Discuss the relationship of radioactivity to human health.
- 8) Define and discuss the concept of half-life.
- 9) Define, differentiate between, and discuss how both nuclear fission and fusion have affected human life.
- 10) Describe x-ray radiation and its source.
- 11) Describe the basic components of a nuclear electric power plant.
- 12) Describe methods of dealing with nuclear waste.

Unit V: Chapters 20 (to p. 494), 22, 24, and 25

Learning Objectives: Upon completion of this unit you will be able to:

- 1) Identify the basic structure, parts, and function of the cell.
- 2) List and explain the 3 major components of cell theory.
- 3) Describe cell membranes and their function.
- 4) Describe in general terms how primitive cells and more-specialized cells differ in the way they extract energy from molecules.
- 5) Define genetic engineering and discuss at least 3 examples of widely used products; discuss pros and cons.
- 6) Explain the basic principles of cloning; discuss pros and cons.
- 7) Describe stem cells and their potential uses; discuss pros and cons.
- 8) Define gene therapy; discuss pros and cons.
- 9) Discuss ethical issues related to genetic engineering and related technology.
- 10) Describe some fundamental differences between cancer cells and normal cells.
- 11) Identify at least 2 ways DNA can be damaged, the frequency of DNA damage, and the basics of natural DNA repair in cells.
- 12) Explain how antibiotic resistance evolves.
- 13) Discuss how evolution can be considered both a fact and a theory.
- 14) Identify at least 3 lines of evidence to support evolution.
- 15) Compare and contrast artificial selection and natural selection.
- 16) Explain the notion of "fitness" in Darwin's theory of evolution.
- 17) Define mass extinction and discuss at least one example.

Schedule of Classes Fall 2006*

Week 1 8/28-9/1 Tuesday Thursday	Introduction and Chapter 1 Chapters 1 & 2
Week 2 9/4-9/8 Tuesday Thursday	Chapters 2 & 3 Chapter 3 and Review
Week 3 9/11-9/15 Tuesday Thursday	Test I ; Science News (3) DUE Chapter 4
Week 4 9/18-9/22 Tuesday Thursday	Chapter 5 Chapter 6
Week 5 9/25-9/29 Tuesday Thursday	Review; Oral Science News Test II
Week 6 10/2-10/6 Tuesday Thursday	Chapter 8 Chapters 8 & 9
Week 7 10/9-10/13 Tuesday Thursday	Chapters 9 & 10 Chapter 10
Week 8 10/16-10/20 Tuesday Thursday	Review; Oral Science News Test III ; Science News (4) DUE
Week 9 10/23-10/27 Tuesday Thursday	Chapter 12 Chapter 12 & 13
Week 9 10/30-11/3 Tuesday Thursday	Chapter 13 Review; Oral Science News
Week 10 11/6-11/10 Tuesday Thursday	Holiday Test IV
Week 11 11/13-11/17 Tuesday Thursday	Chapter 20 (to pg. 494) Chapter 22
Week 12 11/20-11/24 Tuesday Thursday	Chapter 24 Holiday
Week 13 11/27-12/1 Tuesday Thursday	Chapter 25 Test V ; Science News (3) DUE
Week 14 12/4-12/8 Tuesday Thursday	Last chance for Oral Science News Review for Final

Final Exam Date: December 13 **Day:** Wednesday **Time:** 10:10- 12:10 **Location:** HB13

* The schedule is subject to change with as much notice as possible. You are responsible for keeping up with any changes that may be made via handouts or announcements in class.